Remarks

The Office Action mailed December 7, 2006, and made final, has been carefully reviewed and the following remarks have been made in consequence thereof.

Claims 1-8, 11-18, and 21-27 are now pending in this application. Claims 1-8, 11-18, and 21-27 are rejected. Claims 9, 10, 19, and 20 have been canceled without prejudice, waiver, or disclaimer.

The rejection of Claims 1-8, 11-18, and 21-27 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement is respectfully traversed.

The Office Action asserts that the "calculating a first phase of one of the images based on a plurality of points of a respiratory cycle of a motion of the object" is not described in the specification. Applicants traverse this assertion and respectfully submit that the phrase "calculating a first phase of one of the images based on a plurality of points of a respiratory cycle of a motion of the object" is described in the originally filed specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention.

Applicants submit that the originally filed specification of the present application, including the figures, describes and supports "calculating a first phase of one of the images based on a plurality of points of a respiratory cycle of a motion of the object." In one example, paragraph [0061] of the originally filed specification provides as follows:

> Step 96 further includes calculating a phase for each image. *The phase of each image is computed as an average of phases of valid respiratory sample points associated with each image.* The phase of each image includes the phase of the mid scan sample point unless confidence level for the mid scan sample point is less than 0. Phases of each respiratory sample point of the respiratory signal range between 0 and 2π. When calculating the phase of each image, phases of each valid respiratory sample point is translated from a 0 to 2π scale to a 0 to 100 scale. If a valid respiratory sample point cannot be found for an image, the image is

> a “Phase-Less” image. A “phase-less” image is excluded from the automatic image selection, which is described below. However, the user can also select a “phase-less” image manually. (Emphasis added.)

In other words, the originally filed specification describes calculating a phase of one of the images based on a plurality of points of a respiratory cycle.

In addition, there are other examples in the originally filed specification and the Figures that describe calculating a phase of an image based on a plurality of points of a respiratory cycle of a motion of the object.

For at least the reasons set forth above, Applicants respectfully request that the Section 112 rejection of Claims 1-8, 11-18, and 21-27 be withdrawn.

The rejection of Claims 1, 6, 7, 11, 16, 17, 21, 22, and 24 under 35 U.S.C. § 102(e) as being anticipated by Okerlund (U.S. Patent No. 6,526,117) (“Okerlund”) is respectfully traversed.

Okerlund describes a method for generating an optimally registered working set of computer tomography images. A Region of Interest, or a ROI, (43) is divided into separate sub-volumes (122, 124 ...134) that each correspond to each diastolic phase (DP) of a patient. A separately acquired image set (106, 108...118) corresponds to each of the sub-volumes (122, 124...134) such that each image set (106, 108...118) corresponds to a diastolic phase (DP). A system operator selects a specific phase point or location (SP) from within the diastolic phase (DP) at which an image reconstructor (68) should create transaxial slice images. The reconstructor (68) retrieves a sub-set of image data corresponding to a phase range (Ψ_N) centered on the phase location (SP) to generate a transaxial slice image set (106(Ψ_N), 108(Ψ_N)...118(Ψ_N)). Each image set (106(Ψ_N), 108(Ψ_N)...118(Ψ_N)) corresponds to a separate ROI sub-volume (122, 124...134).

To facilitate aligning image sets (106(Ψ_N), 108(Ψ_N)...118(Ψ_N)) with each other, the diastolic phase (DP) may be sub-divided into separate phase ranges (Ψ_{N-2}, Ψ_{N-1}, Ψ_N, Ψ_{N+1}, Ψ_{N+2}), where separate phase dependent image slice data sets (112(Ψ_{N-2}), 112(Ψ_{N-1}), 112(Ψ_N), 112(Ψ_{N+1}), 112(Ψ_{N+2})) correspond to each phase range (Ψ_{N-2}, Ψ_{N-1}, Ψ_N, Ψ_{N+1}, Ψ_{N+2}). Image sets (106, 108...118) corresponding to adjacent ROI sub-volumes (122, 124 ...134) are compared to identify an optimal working set that includes a separate image set (106, 108...118) to correspond to each sub-volume (122, 124 ...134). An image set (112(Ψ_{N-2}), 112(Ψ_{N-1}), 112(Ψ_{N+1}), 112(Ψ_{N+2})) from another phase within the sub-volume image set (106, 108...118) may be substituted for a misaligned image set (112(Ψ_N)) to facilitate increasing the diagnostic characteristics of an optimal working image set such that the optimal set may include image sets (106, 108...118) taken at different phase ranges (Ψ_{N-2}, Ψ_{N-1}, Ψ_N, Ψ_{N+1}, Ψ_{N+2}). Notably, Okerlund does not describe or suggest calculating a phase of an image based on a plurality of points of a respiratory cycle of a motion of an object.

Initially, Applicants respectfully traverse the assertion made in the Office Action that calculating phases of the images would be "inherently met by the [Okerlund] disclosure." Okerlund describes separate image sets that correspond to each diastolic phase. As such, calculating a phase of an image is not inherently taught because the image set as acquired corresponds to a diastolic phase.

Claim 1 recites a method for retrospective internal gating, the method comprising "scanning a patient to obtain projection data; generating images from the projection data; obtaining a signal representing information regarding a physiological cycle of an object within the patient; calculating a first phase of one of the images based on a plurality of points of a respiratory cycle of a motion of the object; specifying at least one target phase based on which the images can be sorted; and sorting the images based on the target phase within the respiratory cycle of the motion of the object to generate at least one series of images."

Okerlund does not describe or suggest a method for retrospective internal gating as recited in Claim 1. Specifically, Okerlund does not describe or suggest calculating a first phase of one of the images based on a plurality of points of a respiratory cycle of a motion of an object. Rather, Okerlund describes separately acquiring an image set for each diastolic phase such that a phase range image sub-set from one diastolic phase image set may be aligned with a phase range image sub-set from an adjacent diastolic phase image set. A description of acquiring separate image sets for each diastolic phase does not teach calculating a phase of an image based on a plurality of points of a respiratory cycle of a motion of an object. Accordingly, Okerlund does not describe or suggest calculating a first phase of one of the images based on a plurality of points of a respiratory cycle of a motion of the object. For the reasons set forth above, Claim 1 is submitted to be patentable over Okerlund.

Claims 6 and 7 depend from independent Claim 1. When the recitations of Claims 6 and 7 are considered in combination with the recitations of Claim 1, Applicants submit that Claims 6 and 7 likewise are patentable over Okerlund.

Claim 11 recites a system for imaging a moving object within a patient, the system comprising "a scanner configured to acquire projection data of the patient; an image reconstructor configured to generate images corresponding to the projection data; and a controller configured to: receive a signal representing information regarding a motion of the object; calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object; enable a user to specify at least one target phase; and sort the images based on the target phase within the respiratory cycle of the motion of the object to generate at least one series of images."

Okerlund does not describe or suggest a system for imaging a moving object as recited in Claim 11. Specifically, Okerlund does not describe or suggest a controller configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. Rather, Okerlund describes separately acquiring an image set for each diastolic phase such that a phase range image sub-set from one diastolic phase image set may be aligned with a phase range image sub-set from an adjacent diastolic phase image set. A description of acquiring separate image sets for each diastolic phase does not teach a controller configured to calculate a phase of an image based on a plurality of points of a respiratory cycle of a motion of an object. Accordingly, Okerlund does not describe or suggest a controller configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. For the reasons set forth above, Claim 11 is submitted to be patentable over Okerlund.

Claims 16 and 17 depend from independent Claim 11. When the recitations of Claims 16 and 17 are considered in combination with the recitations of Claim 11, Applicants submit that Claims 16 and 17 likewise are patentable over Okerlund.

Claim 21 recites a system for imaging a moving object within a patient, the system comprising "a computed tomography (CT) scanner configured to acquire projection data of the patient; an image reconstructor coupled to the CT scanner and configured to generate images corresponding to the projection data; and a controller coupled to the image reconstructor and configured to: receive a signal representing information regarding a motion of the object; calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object; enable a user to specify at least one target phase; and sort the images based on the target phase within the respiratory cycle of the motion of the object to generate at least one series of images."

Okerlund does not describe or suggest a system for imaging a moving object as recited in Claim 21. Specifically, Okerlund does not describe or suggest a controller coupled to the image reconstructor and configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. Rather, Okerlund describes separately acquiring an image set for each diastolic phase such that a phase range image sub-set from one diastolic phase image set may be aligned with a phase range image sub-set from an adjacent diastolic phase image set. A description of acquiring separate image sets for each diastolic phase does not teach a controller coupled to the image reconstructor and configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. Accordingly, Okerlund does not describe or suggest a controller coupled to the image reconstructor and configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. For the reasons set forth above, Claim 21 is submitted to be patentable over Okerlund.

Claim 22 recites a computer configured to "instruct a scanner to acquire projection data of the patient; instruct an image reconstructor to generate images corresponding to the projection data; receive a signal representing information regarding a motion of the object; calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object; enable a user to specify at least one target phase; and sort the images based on the target phase within the respiratory cycle of the motion of the object to generate at least one series of images."

Okerlund does not describe or suggest a computer as recited in Claim 22. Specifically, Okerlund does not describe or suggest a computer configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. Rather, Okerlund describes separately acquiring an image set for each diastolic phase such that a phase range image sub-set from one diastolic phase image set may be aligned with a phase range image sub-set from an adjacent diastolic phase image set. A description of acquiring separate image sets for each diastolic phase does not teach a computer configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle. Accordingly, Okerlund does not describe or suggest a computer configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. For the reasons set forth above, Claim 21 is submitted to be patentable over Okerlund.

Claim 24 recites a computer-readable medium encoded with a program configured to "instruct a scanner to acquire projection data of the patient; instruct an image reconstructor to generate images corresponding to the projection data; receive a signal representing information regarding a motion of the object; calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object; enable a user to specify at least one target phase; and sort the images based on the target phase within the respiratory cycle of the motion of the object to generate at least one series of images."

Okerlund does not describe or suggest a computer-readable medium as recited in Claim 24. Specifically, Okerlund does not describe or suggest a program configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. Rather, Okerlund describes separately acquiring an image set for each diastolic phase such that a phase range image sub-set from one diastolic phase image set may be aligned with a phase range image sub-set from an adjacent diastolic phase image set. A description of acquiring separate image sets for each diastolic phase does not teach a computer-readable medium encoded with a program configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle. Accordingly, Okerlund does not describe or suggest a computer-readable medium encoded with a program configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. For the reasons set forth above, Claim 24 is submitted to be patentable over Okerlund.

For at least the reasons set forth above, Applicants respectfully request that the Section 102 rejection of Claims 1, 6, 7, 11, 16, 17, 21, 22, and 24 be withdrawn.

The rejection of Claims 2-5, 8, 12-15, 18, 23, and 25 under 35 U.S.C. § 103(a) as being unpatentable over Okerlund in view of Kaufman et al. (U.S. Pat. No. 7,006,862) ("Kaufman") in further view of Heuscher et al. (U.S. Pat. App. Pub. No. 2003/0007593) ("Heuscher") is respectfully traversed.

Okerlund is described above. Kaufman describes a gating method. In the gating method, to select a plurality of images that are obtained during diastole, heart frequency information can be used along with information obtained with a plurality of derivative filters to obtain time and phase information to generate an image in which the heart is at its largest volume.

Heuscher describes a computed tomography imaging method. In the method, electrocardiograph (ECG) data is analyzed (108) to identify a number of cardiac cycles corresponding to a selected number of cardiac cycles (106), and to identify a temporal point in each cardiac cycle corresponding to an occurrence of a selected cardiac state (110).

Claims 2-5 and 8 depend, directly or indirectly, from independent Claim 1, which recites a method for retrospective internal gating, the method comprising "scanning a patient to obtain projection data; generating images from the projection data; obtaining a signal representing information regarding a physiological cycle of an object within the patient; calculating a first phase of one of the images based on a plurality of points of a respiratory cycle of a motion of the object; specifying at least one target phase based on which the images can be sorted; and sorting the images based on the target phase within the respiratory cycle of the motion of the object to generate at least one series of images."

None of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest a method for retrospective internal gating as recited in Claim 1. Specifically, none of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest calculating a first phase of one of the images based on a plurality of points of a respiratory cycle of a motion of an object. Rather, Okerlund describes separately acquiring an image set for each diastolic phase such that a phase range image sub-set from one diastolic phase image set may be aligned with a phase range image sub-set from an adjacent diastolic phase image set. A description in Okerlund of acquiring separate image sets for each diastolic phase does not teach calculating a phase of an image based on a plurality of points of a respiratory cycle of a motion of an object.

Furthermore, Kaufman describes generating an image in which a heart is at its largest volume by obtaining time and phase information. Heuscher describes identifying a number of cardiac cycles corresponding to a selected number of cardiac cycles and identifying a temporal point in each cardiac cycle corresponding to an occurrence of a selected cardiac state by analyzing electrocardiograph data. Accordingly, none of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest calculating a first phase of one of the images based on a plurality of points of a respiratory cycle of a motion of the object. For the reasons set forth above, Claim 1 is submitted to be patentable over Okerlund in view of Kaufman, in further view of Heuscher.

When the recitations of Claims 2-5 and 8 are considered in combination with the recitations of Claim 1, Applicants submit that dependent Claims 2-5 and 8 likewise are patentable over Okerlund in view of Kaufman, in further view of Heuscher.

Claims 12-15 and 18 depend, directly or indirectly, from independent Claim 11, which recites a system for imaging a moving object within a patient, the system comprising "a scanner configured to acquire projection data of the patient; an image reconstructor configured to generate images corresponding to the projection data; and a controller configured to: receive a signal representing information regarding a motion of the object; calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object; enable a user to specify at least one target phase; and sort the images based on the target phase within the respiratory cycle of the motion of the object to generate at least one series of images."

None of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest a system for imaging a moving object as recited in Claim 11. Specifically, none of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest a controller configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. Rather, Okerlund describes separately acquiring an image set for each diastolic phase such that a phase range image sub-set from one diastolic phase image set may be aligned with a phase range image sub-set from an adjacent diastolic phase image set. A description in Okerlund of acquiring separate image sets for each diastolic phase does not teach calculating a phase of an image based on a plurality of points of a respiratory cycle of a motion of an object.

Furthermore, Kaufman describes generating an image in which a heart is at its largest volume by obtaining time and phase information. Heuscher describes identifying a number of cardiac cycles corresponding to a selected number of cardiac cycles and identifying a temporal point in each cardiac cycle corresponding to an occurrence of a selected cardiac state by analyzing electrocardiograph data. Accordingly, none of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest a controller configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. For the reasons set forth above, Claim 11 is submitted to be patentable over Okerlund in view of Kaufman, in further view of Heuscher.

When the recitations of Claims 12-15 and 18 are considered in combination with the recitations of Claim 11, Applicants submit that dependent Claims 12-15 and 18 likewise are patentable over Okerlund in view of Kaufman, in further view of Heuscher.

Claim 23 depends from independent Claim 22, which recites a computer configured to "instruct a scanner to acquire projection data of the patient; instruct an image reconstructor to generate images corresponding to the projection data; receive a signal representing information regarding a motion of the object; calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object; enable a user to specify at least one target phase; and sort the images based on the target phase within the respiratory cycle of the motion of the object to generate at least one series of images."

None of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest a computer as recited in Claim 22. Specifically, none of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest a computer configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. Rather, Okerlund describes separately acquiring an image set for each diastolic phase such that a phase range image sub-set from one diastolic phase image set may be aligned with a phase range image sub-set from an adjacent diastolic phase image set. A description in Okerlund of acquiring separate image sets for each diastolic phase does not teach calculating a phase of an image based on a plurality of points of a respiratory cycle of a motion of an object.

Furthermore, Kaufman describes generating an image in which a heart is at its largest volume by obtaining time and phase information. Heuscher describes identifying a number of cardiac cycles corresponding to a selected number of cardiac cycles and identifying a temporal point in each cardiac cycle corresponding to an occurrence of a selected cardiac state by analyzing electrocardiograph data. Accordingly, none of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest a computer configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. For the reasons set forth above, Claim 22 is submitted to be patentable over Okerlund in view of Kaufman, in further view of Heuscher.

When the recitations of Claim 23 are considered in combination with the recitations of Claim 22, Applicants submit that dependent Claim 23 likewise is patentable over Okerlund in view of Kaufman, in further view of Heuscher.

Claim 25 depends from independent Claim 24 which recites a computer-readable medium encoded with a program configured to "instruct a scanner to acquire projection data of the patient; instruct an image reconstructor to generate images corresponding to the projection data; receive a signal representing information regarding a motion of the object; calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object; enable a user to specify at least one target phase; and sort the images based on the target phase within the respiratory cycle of the motion of the object to generate at least one series of images."

None of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest a computer-readable medium as recited in Claim 24. Specifically, none of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest a computer-readable medium encoded with a program configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. Rather, Okerlund describes separately acquiring an image set for each diastolic phase such that a phase range image sub-set from one diastolic phase image set may be aligned with a phase range image sub-set from an adjacent diastolic phase image set. A description in Okerlund of acquiring separate image sets for each diastolic phase does not teach calculating a phase of an image based on a plurality of points of a respiratory cycle of a motion of an object.

Furthermore, Kaufman describes generating an image in which a heart is at its largest volume by obtaining time and phase information. Heuscher describes identifying a number of cardiac cycles corresponding to a selected number of cardiac cycles and identifying a temporal point in each cardiac cycle corresponding to an occurrence of a selected cardiac state by analyzing electrocardiograph data. Accordingly, none of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest a computer-readable medium encoded with a program configured to calculate a first phase of one of the images based on a plurality of points of a respiratory cycle of the motion of the object. For the reasons set forth above, Claim 24 is submitted to be patentable over Okerlund in view of Kaufman, in further view of Heuscher.

When the recitations of Claim 25 are considered in combination with the recitations of Claim 23, Applicants submit that dependent Claim 25 likewise is patentable over Okerlund in view of Kaufman, in further view of Heuscher.

Moreover, Applicants respectfully submit that the Section 103 rejection of Claims 2-5, 8, 12-15, 18, 23, and 25 is not a proper rejection. As is well established, obviousness cannot be established by combining the teachings of the cited art to produce the claimed invention, absent some teaching, suggestion, or incentive supporting the combination. None of Okerlund, Kaufman, nor Heuscher, considered alone or in combination, describe or suggest the claimed combination. Furthermore, in contrast to the assertion within the Office Action, Applicants respectfully submit that it would not be obvious to one skilled in the art to combine Okerlund with Kaufman and/or Heuscher because there is no motivation to combine the references suggested in the cited art itself.

As the Federal Circuit has recognized, obviousness is not established merely by combining references having different individual elements of pending claims. Ex parte Levengood, 28 U.S.P.Q.2d 1300 (Bd. Pat. App. & Inter. 1993). MPEP 2143.01. Rather, there must be some suggestion, outside of Applicants' disclosure, in the prior art to combine such references, and a reasonable expectation of success must be both found in the prior art, and not based on Applicants' disclosure. In re Vaeck, 20 U.S.P.Q.2d 1436 (Fed. Cir. 1991). In the present case, neither a suggestion or motivation to combine the prior art disclosures, nor any reasonable expectation of success has been shown.

Furthermore, it is impermissible to use the claimed invention as an instruction manual or "template" to piece together the teachings of the cited art so that the claimed invention is rendered obvious. Specifically, one cannot use hindsight reconstruction to pick and choose among isolated disclosures in the art to deprecate the claimed invention. Further, it is impermissible to pick and choose from any one reference only so much of it as will support a given position, to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one of ordinary skill in the art. The present Section 103 rejection is based on a combination of teachings selected from multiple patents in an attempt to arrive at the claimed invention. Specifically, Okerlund et al. teach separately acquiring an image set for each diastolic phase such that a phase range image sub-set from one diastolic phase image set may be aligned with a phase range image sub-set from an adjacent diastolic phase image set. Kaufman et al. teach generating an image in which a heart is at its largest volume by obtaining time and phase information. Heuscher et al. teach identifying a number of cardiac cycles corresponding to a selected number of cardiac cycles and identifying a temporal point in each cardiac cycle corresponding to an occurrence of a selected cardiac state by analyzing electrocardiograph data.

Since there is no teaching nor suggestion in the cited art for the combination, the Section 103 rejection appears to be based on a hindsight reconstruction in which isolated disclosures have been picked and chosen in an attempt to deprecate the present invention. Of course, such a combination is impermissible, and for this reason alone, Applicants request that the Section 103 rejections of Claims 2-5, 8, 12-15, 18, 23, and 25 be withdrawn.

For at least the reasons set forth above, Applicants respectfully request that the rejections of Claims 2-5, 8, 12-15, 18, 23, and 25 under 35 U.S.C. 103(a) be withdrawn.

In view of the foregoing amendment and remarks, all the claims now active in this application are believed to be in condition for allowance. Reconsideration and favorable action is respectfully solicited.

Respectfully submitted,

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